FINAL REPORT

19970402

MEDICINAL HERBS

May 2002
Funded by the Agri-Food Innovation Fund

Prepared by: NorSask Botanicals

AGRI-FOOD INNOVATION FUND

Canada

Saskatchewan

102-05825/

AGRI-FOOD INNOVATION FUND

Canada Saskatchewan

Medicinal Herb Production in Northeast Saskatchewan 2001

Co-ordinated by

NorSask Botanicals Inc.
Sask. Agriculture & Food
Herb Research Program
Sask. Herb & Spice Assoc.

Medicinal Herb Production in North East Saskatchewan

Project # 97000402 Summary

Demonstration sites were located at Prince Albert, Tisdale and a satellite site at Bjorkdale.
Project objectives included;

- Providing an opportunity to observe a variety of medicinal herbs throughout plant development,
- The collection of agronomic and economic information,
- Assessing the potential cultivation of native plants with commercial potential.

These sites have been used as a tool to increase agronomic and economic knowledge of medicinal herbs. On-site guided tours were held at both locations with resource people providing information. Self-guided tour information was available on-site for those unable to attend the guided tours. Interest peaked in 1998 & 1999. The co-ordinators received fewer visits and calls in 2000 and 2001. The media helped bring the information to producers thoughout the four years with articles in local and provincial papers.

Correspondence with interested growers has shown an increased awareness of terms and procedures, which are critical to the success of this new industry. It has also given producers a chance to discuss production practices and learn from each other. The Northeast has two very active growers groups; Northern Lights Herbs Inc. @ Prince Albert and NorSask Botanicals Inc. @ Arborfield.

The annual report contains agronomic information collected on plant establishment, development, and harvest. These sites supplied a hands-on instrument to assist grower groups and Sask. Ag & Food in their efforts to educated new growers.

The plots were set up for demonstration purposes, however throughout the four years of operations observation have brought the following conclusions:

- The use of poly to reduce weed pressure and save moisture has been very beneficial. The addition of T-tape irrigation was an inexpensive labor-friendly way to supply water to the plots. The combination of T-tape irrigation and poly mulch has been significant in the establishment success of crops such as Echinacea angustifolia, chamomile and catnipthat were direct seeded in the fall.

- Feverfew, valerian, astragalus, fireweed and catnip established better with transplants. Direct seeding of these crops was sporadic and provided poor crop establishment.

- Concerns about crop rotation are very relevant as we have seen the decreased productivity of valerian, german chamomile, burdock and feverfew at all three sites. These observations included increased disease, yellowing of foliage, and decreased size and performance of aerial and root production.

- The Prince Albert and Tisdale sites have a heavy clay soil texture. These soils limited the depth we could achieve when harvesting roots and increased root damage. The soil compaction that takes place in the three years the plants need to mature also adds to harvesting difficulties. Mechanical harvesting is a must in order to unearth the entire rootstock. Cleaning of the root was also more labor intensive and damaged more of the fibrous roots than in the a sandy –loam textured soil at Bjorkdale.

Project Objectives:

- To assist producers in Northeast Saskatchewan to establish a new agriculture industry involving the production, processing and marketing of medicinal herbs.
- Maintain demonstration sites that will allow producers the opportunity to observe a variety of medicinal herbs throughout the plant development.
- Gather agronomic data such as plant adaptability, yields, weed control and other production problems to help producers assess the economic feasibility of medicinal herb production.
- Evaluate the cultivation of native species that have an identified commercial potential such as fireweed.

Project Description

Medicinal herbs offer a new option to small farmers and acreage holders due to their high value, relatively small acreage requirements and a rapidly expanding market. High value herbs destined for the medicinal market are generally organically grown, offering a more sustainable farming option. A great deal of interest has been stimulated across Saskatchewan in the production of herbs. However there is very little information available on the production practices and the economics of producing medicinals here in our climatic conditions. Lack of reliable information on processing and marketing of medicinal herbs is another limiting factor.

Demonstration sites will provide farmers with the opportunity to look at these new crops; they allow the collection of production information such as cost, yield, and labour requirements; they also provide herb products for quality analysis, test processing and test marketing. The location of the two primary sites is as follows;

The Northeast Demonstration Farm, six miles north of Tisdale on highway #35
Contact persons include: Leroy Bader PAg, Extension Agrologist @ 878-8805
Dianne Horn, Project Co-ordinator @ 886-2211

The Conservation Learning Centre, south of Prince Albert on highway #2
Contact persons include: Barry Swanson PAg, Extension Agrologist @ 953-2780
Jo Detillieux, Project Co-ordinator @ 764-8207

As both our primary sites have heavy clay soil compositions which makes harvesting of root crops difficult a secondary site was established on a producers farm four miles west of Bjorkdale. The soil conditions on this site are sandy loam and more favourable for growing root crops. Echinacea, valerian and burdock are the three species being tested at Bjorkdale.

All the sites are signed and have self-guided plot information available so producers can stop and view the plants at different stages of growth and at a time when it is convenient to them.

Selected Plants:

The herbs selected for production in plots reflect the relative economic importance of the herb and its adaptability to the climate and agriculture of Northeast Saskatchewan. With these parameters in mind the following plants were selected:

- Echinacea angustifolia
- Burdock
- Valerian
- Feverfew
- German chamomile
- Astragalus
- Fireweed
- Seneca root

Plot Parameters:

- The production of herbs will follow commonly adopted practices of growers where available.
- Plant establishment will primarily be with the use of plugs and where direct seeding appears to be feasible, comparisons will be looked at.
- Since the medicinal market looks at organic production as a quality factor, the plots will be maintained using organic practices.
- Variables that will be demonstrated within the plot layout include;
    - Plastic mulch/no mulch,
    - Irrigation/no irrigation,
    - Direct seed verses transplants
- Plot size and row spacing will vary with the herb and expected harvest procedure.

**** Please keep in mind that these sites do not have replicated plots and therefore the results reported here are observations only and are <u>not</u> statistically accurate. The main purpose of the project was for visual demonstration.***

Winter Morality Counts:

Each year the plots were assessed in the spring to determine plant loss of perennials due to winterkill. The following chart sums up that data.

Winter morality spring 2001

Catnip (Third year) - **Tisdale Site**			
Description of plot variables	# of plants established	# of plants showing regrowth	% of survival
Direct seeded/poly/no irrigation	8	7	87 %
Direct seeded/poly/irrigation	10	10	100 %
Transplants/poly/no irrigation	18	18	100 %
Transplants/no poly/no irrigation	18	17	94 %
Transplants/poly/irrigated	15	12	80 %
Transplants/no poly/irrigated	20	15	75 %
Echinacea angustifolia - Third Year - Tisdale Site			
Description of plot variables	# of plants established	# of plants showing regrowth	% of survival
Direct seeded/poly/no irrigation	9	8	88 %
Direct seeded/poly/irrigation	12	8	66 %
Transplants/poly/no irrigation	26	22	84 %
Transplants/no poly/no irrigation	18	14	77 %
Transplants/poly/irrigated	30	26	86 %
Transplants/no poly/irrigated	32	32	100 %
Astragalus (Fourth year) - **Tisdale Site**			
Description of plot variables	# of plants established	# of plants showing regrowth	% of survival
Direct seeded/poly/no irrigation	22	7	31 %
Direct seeded/poly/irrigation	22	5	22 %
Direct seeded/no poly/no irrigation	19	19	100 %
Direct seeded/no poly/ irrigation	19	18	94 %
Transplants/poly/no irrigation	20	13	65 %
Transplants/no poly/no irrigation	22	20	90 %
Transplants/poly/irrigated	20	8	40 %
Transplants/no poly/irrigated	22	18	81 %

Feverfew:

Tisdale Site: The feverfew did not over-winter well and sustained 92% mortality. Feverfew should be considered an annual in our zone.

Fireweed:

Tisdale Site: There was little over-wintering loss in the fireweed. The plants were healthy and generated new rhizomes.
CLC Site: Fireweed over-wintered well with no apparent losses.

Fall Seeding Demonstration:

A fall seeding demonstration was set up at the Tisdale site. In late October 2000 holes were punched into the poly and seeds lay on top of the soil. In spring of 2001 the results were as follows:

Species which did germinate	Species which did not germinate
Valerian	Feverfew
Echinacea angustifolia	German Chamomile
Catnip	Astragalus
	Fireweed

Agronomic Information:

Catnip

Tisdale Site: Catnip was chosen to replace burdock at our Tisdale site, as the heavy clay soil conditions are unfavourable for root harvesting.
Direct seeding was done on July 16th, 1999. The direct seeded rows established well enough to be harvested in 2000. Transplants were also put in on July 16th, 1999. Two rows one foot apart with 6" between plants were established. The plants established and over-wintered well. Harvesting of the top 2/3rds of the aerial portion was done by hand in 2000 and 2001. The plants were then laid out in a dark greenhouse to be dried then weighted. Catnip and astragalus tolerated the drought significantly better than all other species

Yield

Catnip (third year) - **Tisdale Site Harvested August 28, 2001**		
Description of plot variables	# of plants	Dry weight
Direct seeded/poly/no irrigation	7	2 lb. 4 ounces
Direct seeded/poly/irrigation	10	3 lb. 2 ounces
Transplants/poly/no irrigation	18	3 lb. 14 ounces
Transplants/no poly/no irrigation	17	3 lb. 2 ounces
Transplants/poly/irrigated	12	3 lb. 6 ounces
Transplants/no poly/irrigated	15	2 lb. 15 ounces

CLC Site: Catnip was substituted for feverfew at the Conservation Learning Centre for 2001.
Establishment was done through transplants on June 19/01. These plugs were quite mature at the time of transplant and 100% establishment was achieved. The plot was harvested by removing the top 2/3rds of the plant and dried at 78 degrees with forced air for 5 days.

Yield

Catnip (first year) - **CLC Site Harvested July 24, 2001**	
Description of plot variables	Dry weight
Transplants/poly/no irrigation	9.8 lb.
Transplants/poly/irrigated	12.8 lb.

German Chamomile

Tisdale Site: Direct seeding took place on May 23rd, 2001. Again there was poor germination leading to very low yields in the direct seeded plots.
Transplants were put in on May 23rd, 2001. Chamomile transplants were taken from plants that had reseeded themselves at the site. The plants remained small and unproductive through out he growing season. This plot was not harvested, as plants remained unproductive due to inadequate moisture at the site.

CLC Site: Instead of direct seeding the plot at the CLC was left to see if we would have establishment from self-seeding of the 2000 crop. This was not successful perhaps due to the lack of snow cover at the site A single harvest was taken on August 1/01 and the harvested material was laid out to dry in a warm, dry, barn loft.
The plants in this plot were not vigorous and remained leggy and thin throughout the growing season. The foliage of the plants showed signs of yellowing also. The plants did not regenerate well enough to allow a second cut.

Yield

German Chamomile - CLC Site Harvested August 01, 2001	
Description of plot variables	Dry weight
Transplants/poly/no irrigation	2 lb.
Transplants/poly/irrigated	2.4 lb.

Burdock

Bjorkdale Site: Direct seeding was completed on May 28th, 2001. Seeding was done using an earthway single row seeder. Each year the burdock is seeded directly ontop of the previous year's plot. Even though germination was successful the plants were small with top growth remaining dwarfed throughout the entire growing season. Roots were dug with a spade and washed using a pressure washer then dried in a dark greenhouse. The soil was extremely dry at time of harvest and with no u-bar digger available the roots were lifted using a spade, which lead to considerable root damage.

Yield

Burdock - Bjorkdale Site Harvested October 28, 2001	
Description of plot variables	Dry weight
Direct seeded/ no poly/no irrigation	3 lbs. 1 ounces
Direct seeded/ no poly/irrigation	2 lbs. 5 ounces

CLC Site: Direct Seeding was done on May 26, 2001. Despite watering the rows at establishment germination was poor. The irrigated row had 37% germination and the non-irrigated row reached 34% germination. Visually the leaves were smaller and slower growing than in previous years. On October 19, 2001 the roots were harvested using a u-bar digger, washed and dried in the Pami drier. The roots achieved a length of approxmently 18 inches but were skinny, weighting up considerably less than in 2000.

Yield

Burdock - CLC Site Harvested October 19, 2001	
Description of plot variables	Dry weight
Direct seeded/ poly/no irrigation	1 lbs. 2 ounces
Direct seeded/ poly/irrigation	1 lbs. 2 ounces

Feverfew

Tisdale Site: Direct seeding was done on May 28, 2001. Poor germination was experienced in all direct seeded plots even with irrigation. Transplants were established June 7, 2001. Establishment of the entire plot was burdened by the hot dry weather experienced at the plot through out the entire growing season. Plants remained unproductive therefor; no attempt at weighing the yield was made.

Astragalus

Tisdale Site: The plants in this plot are now four years old. They again reached a height of five feet and set seed prior to harvest. There were a few plants that did not find their way through the poly. The non-poly plots had a 100% survival rate. The plants remained healthily through out the year and showed very little effects from the dry conditions in 2001. Harvesting of these roots was attempted in October of 2001. The heavy clay soil combined with the dry, compacted condition of the soil limited the harvest to the top four to five inches of the root. It was decided that the results would be inconclusive and the harvest painstakingly labour intensive so some roots were merely left.

CLC Site: The fourth year plants that were established via transplant in 1998 were harvested using a u-bar digger. The roots were washed and dried weighing from 2 ounces/root to 7-ounces/ root.

Fireweed

Tisdale Site: The winter hardness and regenerating capabilities of this plant makes for easy establishment . There has been no winterkill on this plot. Rhizomes continue spreading through out the plot and the mature plants are bushier and taller than in 2000. The top 2/3rds of the plants were harvested at early bloom. The product was then taken into a dark green house to dry for 14 days then be weighted. Fireweed must be laid out in shallow layers to avoid moulding.

Yield

Fireweed - Tisdale Site Harvested July 30, 2001	
Description of plot variables	Dry weight
Transplanted/no poly/no irrigation	5 lb. 4 ounce
Transplanted/no poly/irrigation	6 lb. 1 ounce

CLC Site: There is a very high winter survival rate in the fireweed. Significant spreading due to rhizomes activity was less than in previous years. Even though the plot is managed with poly and wood chips the dandelion and sow thistle are competing for space. There were far fewer vertical rhizomes due to the increased weed pressure and/or drought conditions.

Yield

Fireweed - CLC Site Harvested July 26 , 2001	
Description of plot variables	Dry weight
Transplanted/poly/no irrigation	4 lb.
Transplanted/poly/irrigation	4 lb.

Echinacea angustifolia

Tisdale Site: This plot was re-established in 1999 due to large winterkill losses. The direct seeding under poly generated enough plants that there was no need to direct seed again in 2000, however, direct seeding without the aid of poly still has little to no establishment success.
Some of the plants we assessed as winterkill in May of 2000 did regenerate and the stands were successful enough to be kept through for third year harvest. There was also little disease in this plot.
The soil was extremely dry at time of harvest. With no u-bar digger available the roots were lifted using a spade which lead to considerable root damage. The soil at the site is heavy clay, which not only hampers harvest but also makes cleaning the root very difficult.

Yield

Echinacea angustifolia (third year) - **Tisdale Site**	**Harvested October 30, 2001**	
Description of plot variables	# of plants	Dry weight
Direct seeded/poly/no irrigation	8	4 ounces
Direct seeded/poly/irrigation	8	5 ounces
Transplants/poly/no irrigation	22	15 ounces
Transplants/no poly/no irrigation	14	6 ounces
Transplants/poly/irrigated	26	1 lb. 1 ounces
Transplants/no poly/irrigated	32	1 lb. 2 ounces

Bjorkdale Site: There was nearly a 60% loss on this plot due to winterkill. The surviving plants bloomed and bore seed and were harvested in the fall of 2001. The soil was very dry and compacted from no cultivation. Even though the soil at this site is a lighter texture it was still very difficult to harvest the root by hand. Perennial weeds such as dandelion and quackgrass invaded the plot and with the dry weather it was very difficult to remove the roots of these plants during weeding. Roots were washed then dried in a greenhouse for 9 days. The majorities of the roots were skinny and did not have any mass four inches after the crown.

Yield

Echinacea angustifolia (third year) - **Bjorkdale Site**	**Harvested October 30, 2001**	
Description of plot variables	# of plants	Dry weight
Direct seeded/poly/no irrigation	11	5 ounces
Direct seeded/poly/irrigation	13	4 ounces
Transplants/poly/no irrigation	16	6 ounces
Transplants/no poly/no irrigation	10	4 ounces
Transplants/poly/irrigated	14	6 ounces
Transplants/no poly/irrigated	13	5 ounces

CLC Site: Echinacea at this site was harvested in its third year in the fall of 2000. One year old transplants from an adjacent Ag. Canada plot were established for visual demonstration. Transplant mortally was high reaching near 60 %. Fall harvest was unsuccessful. Roots snapped off and fragmented at time of harvest due to the drought and heavy clay soil.

Valerian

Tisdale site: Direct seeding took place May 17/00. Rows were spaced one foot apart with one-foot spacing between plants. Germination took 21 days with the irrigated plot having 56% germination and the non-irrigated plot 40%.
Transplants were established June 19,2000 using the same row spacing as the direct seeded plot. Survival rate of both plots was over 80%; however, plants were not robust as in the 1998. Plants turned yellow and only grew to two feet tall before flowering and setting seed. The roots were dug on October 30,2001. Yield was not recorded as the roots were very small and their fibrous make up left little to no weight after drying. The findings at the Bjorkdale plot were very similar, which leads us to believe that crop rotation and drought are having a huge effect on the species.

CLC site: Winter mortality was assessed on May 16,2001. The irrigated row had a 46% survival rate and the non-irrigated row 71%. Plants were yellow and remained sickly all summer. By October 10/01 only 2% of the irrigated row survived and 5% of the non-irrigated row.
Recho Cech of Horizon Herb's states that Valerian is a heavy feeder and requires side dressing of rich compost several times a year. Valerian mortality is therefor likely due to having been in the same location for four consecutive years. 2001 was also the driest year the sites had received.

Observations and Conclusions

The plots were set up for demonstration purposes, however thoughout the four years of operation our observations have resulted in the following conclusions:

- The use of poly to reduce weed pressure and save moisture has been very beneficial. The addition of T-tape irrigation was an inexpensive labor friendly way to supply water to the plots. The combination of T-tape irrigation and poly has been significant in the establishment of crops such as Echinacea angustifolia, chamomile and catnip through direct seeding in the fall.

- Feverfew, valerian, astragalus, fireweed and catnip established better via transplants. Direct seeding of these crops is sporadic and provide poor crop establishment.

- Concerns about crop rotation are very relevant as we have seen the decreased productivity of valerian, german chamomile, burdock and feverfew at all three sites. These observations included increased disease, yellowing of foliage, and decreased performance of aerial and root production.

- The Prince Albert and Tisdale site have a heavy clay soil texture. These soils limited the depth we could achieve when harvesting roots and increased root damage. The soil compaction that takes place in the three years the plant needs to mature also adds to harvesting difficulties. Mechanical harvesting is a must in order to unearth the entire rootstock. Cleaning of the root was also more labor intensive and damaged more of the fibrous roots than in the sandy –loam textured soil at Bjorkdale .

Variety Demonstrations

Over the four years of the project plots have contained herbs and species for identification purposes.

Varieties at the Conservation Learning Centre include:

Burdock
Stinging Nettle
Lovage
Catnip
Senneca
Valerian
Wormwood
Echinacea purpurea
Yarrow
Peppermint
St. John's Wort
Sheep Sorrel
Siberian Motherwort
Mugwort
Silver Sage
Arnica
Milk Thistle
Spearmint
Feverfew
Marshmallow
Chamomile
Comfrey
Primrose
Echinacea angustifolia
Rosemary

Varieties at the Tisdale site include:

Feverfew
Senneca
Valerian
Lamb's Ear
American Ginseng
Siberian Ginseng
Golden Seal
Echinacea purpurea
Silver Sage
Yarrow
St. John's Wort
Stinging Nettle
Ginko Baloba
Sheep Sorrel
Monarda
Hyssop
Elecampne
Comfrey
Prairie Sage
English Lavender
Milk Thistle
Lemon Balm
Garlic
Anise Hyssop
Burduck
Oregano
Thyme
Echinacea angustifolia
Calendula
Rosemary
Skull Cap
Basil
Peppermint

Ginseng and Golden Seal Plot

The Tisdale Demonstration Site had established a demonstration plot for ginseng in 1997. A small plot of American Ginseng was established from seed planted in the fall of 1997. Golden Seal was established from rootstock in the fall of 1998. By the fall of 2001 only a few ginseng plants remain, however one root was a considerable size. The Golden seal had more plants survive but roots remained small.

Plant Identification	Dry Weight/root
Goldenseal (fourth year)	1.2 grams
American Ginseng (fourth year)	2.3 grams

Quality Analysis

Saskatchewan Herb Research Program
Department of Plant Sciences

Certificate of Analysis for Astragalus Root

Company/Grower: Norsask Botanicals Inc., c/o Dianne Horn
Address: Box 36, Aylsham SK S0E 0C0 Canada

Date: April 26, 2002

Sample: Received from Jo Detillieux on October 30, 2001
1. A sample of 2 dry roots of Astragalus (*Astragalus membranaceous*) (our lab. #E-428);

Method: HPLC using external standard and 7 point calibration curve for each of 3 marker compounds (astragaloside I, astragaloside III, astragaloside IV).

Analytical Results:

Sample I.D.	Astragaloside I	Astragaloside III	Astragaloside IV
	% w/w	% w/w	% w/w
Astragalus Root (E-428)	0.14%	trace	trace

Content of marker compounds in the root is expressed on as is basis (moisture < 10%). Should you require additional information, please contact me at 306-966-5868; e-mail: barlb@duke.usask.ca. Thank you for using analytical services of the Saskatchewan Herb Research Program.

Sincerely,

Branka Barl, Ph.D.
Program Leader, Saskatchewan Herb Research Program

Analysis of Astragalus (*Astragalus membranaceus*) Root for the Content of Saponins Called Astragalosides

---

Plant Material: A sample of dry astragalus root harvested in Saskatchewan 2001 was provided by Norsask Botanicals Inc. for analysis on October 30, 2001 (our lab sample E-428). Material was stored in dark dry place at 10°C prior to analysis in March 2002. Root was ground to a fine powder with particle size below 1000 µm using Thomas-Wiley Laboratory Mill.

Extraction Method: Around 10 g of powdered root was extracted with 100 mL of methanol under reflux for 20 min, extract was filtered through cotton wool, and root material extracted two more times with 100 mL methanol each time. The combined filtrates were filtered through Whatman #2 filter paper and then the methanol was evaporated under vacuum at 40 ^{O}C. A weighed portion of dry extract was dissolved in methanol, filtered through 0.45 µm micro-filter and analyzed by high performance liquid chromatography (HPLC) for the content of astragalosides. Saponins astragalosides are one of two classes of chemical compounds that are considered to be biologically active constituents of astragalus root.; polysaccharides are the second class.

HPLC Analysis: Analysis of root extract for the content of astragalosides was performed with Waters system using the Millennium 32 Chromatography Manager software and Waters Nova-Pak RP_{18} column (4µm, 3.9 x 150 mm). Saponins were analyzed using the following elution program: isocratic 90% B (UF water containing 1% of 0.1N H_3PO_4) for 5 min followed by linear gradient to 20% B over 5 min, to 25% B in 10 min, to 33% B in 10 min, to 35%B in 10 min, to 60%B in 10 min. Solvent A is acetonitrile containing 1% of 0.1N H_3PO_4. Flow rate was 1 mL/min and injection volume 2-20 µl. Detection was conducted by PDA at λ=200 nm. Analysis time was 70 min. Three pure standard compounds astragaloside I, II, and IV that became recently available on the market, were individually dissolved in methanol at a concentration 0.8 mg/mL. Seven-point calibration curve (1600-32,000 ng) was generated for each astragoliside by injection of various volumes of standard stock solutions covering range of 1600-32,000 ng. The retention time of three main astragalosides ranged from 36 min to 51 min.

Results: The yield of crude methanol extract from the root was 20.1%. The astragaloside I in the root was found to be at the level of 0.14%. Astragaloside II and IV could only be detected in trace quantities using PDA detection system, but could not be quantified. Therefore, it could be concluded that the content of astragaloside in the root provided by Norsask Botanicals Inc. is higher than 0.14%. It has been recently reported that total saponin content in various astragalus products on the market, which are mainly imported from China, varied from 0.019 to 0.184% as determined by HPLC. This suggests that astragalus grown in Saskatchewan is of very good quality. Interestingly, according to some records close to the industry, astragalus root is often standardized to the minimum amount of 0.4% of an isoflavone compounds (specifically, 4'-hydroxyisoflavone 7-sug).

It is hard to explain the reason for this choice, since isoflavone do not contribute in a significant way to main pharmacological activity of astragalus such as restoration of immunity, increase resistance to disease and infections, restoration of periferal circulation etc. While there are numerous references on physiologac activity of astragalus, information on the content of astragalosides, polysaccharides and isoflavones is scarce.

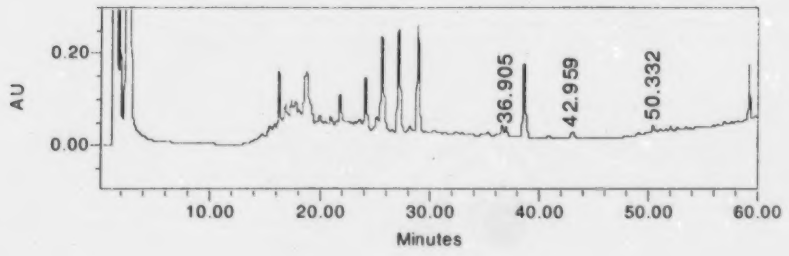

Figure 1. HPLC profile of crude methanolic extract of astragalus root showing astragaloside IV (36.905 min), astragoliside II (42,959 min) and astragaloside I (50.332 min).

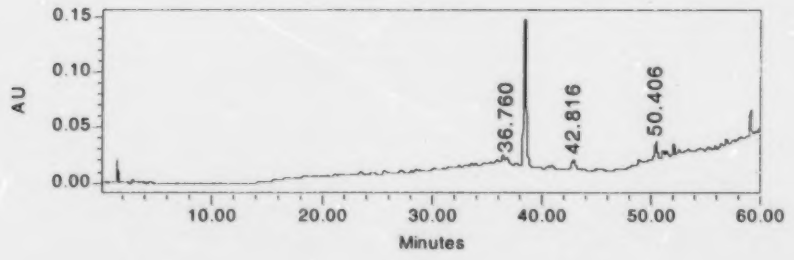

Figure 2. HPLC profile of methanolic extract cleaned of more polar compounds eluting in the first 30 min of the HPLC run; astragalus root showing astragaloside IV (36.905 min), astragoliside II (42,959 min) and astragaloside I (50.332 min).

References:

Ganzera M., Bedir E., Calis I., and Khan I. A. 2001. Separation of *Astragalus* Saponins by Reversed Phase High Performance Liquid Chromatography and Evaporative Light Scattering Detection. *Chromatographia* **53**: 131 - 134.

Saskatchewan Herb Research Program
Department of Plant Sciences

Certificate of Analysis for German Chamomile Essential Oil from Dry Flower Heads

Company/Grower: Norsask Botanicals Inc., c/o Dianne Horn
Address: Box 36, Aylsham SK S0E 0C0 Canada

Date: April 26, 2002

Sample: Received from Jo Detillieux on October 30, 2001

1. A sample of about 100 g of dry German Chamomile flowerh eads with some stem (our lab.
#E-427);

Method: GC using external standard and 7 point calibration curve for β-bisabolol standard; also GC-MS to identify other compounds in the essential oil beside β-bisabolol.

Analytical Results:

Sample I.D.	β-farnasene (%)	27.2 min (%)	Bisabolol oxide b	□-Bisabolol (%)	Chamazulene (%)	30.8 min (%)	33.5 min (%)
E. Oil from German Chamomile Flowerheads (E-427)	11.72	1.84	4.25	45.72	15.36	2.32	7.72

Content of essential oil in German flower heads is expressed on as is basis (moisture < 10%).
Should you require additional information, please contact me at 306-966-5868; e-mail: barlb@duke.usask.ca. Thank you for using analytical services of the Saskatchewan Herb Research Program.

Sincerely,

Branka Barl, Ph.D.
Program Leader, Saskatchewan Herb Research Program

Analysis of German Chamomile flowerheads for the content and composition of essential oil

---

Plant Material: A sample of dry German Chamomile flower heads with some stems harvested in 2001 was provided for analysis to the Herb Research Program on October 30, 2001 (our lab sample E-427). Material was stored in dark dry space at 10°C prior to analysis in March 2002.

Extraction Method: A sample of Chamomile flower heads (85.8 g) was ground using mortar and pestle and extracted for essential oils by cohabitual hydrodistillation in a Clavenger type extractor for 4 hrs. Oil was collected from the top of the water layer in a collection arm of the unit indicating that oil was lighter (has lower density) than water; the remaining small amount of essential oil that moved into a water layer was recovered by extraction with diethyl ether. Ten (10) µL of essential oil was dissolved in 490 µL of diethyl ether and subjected to analysis by gas chromatography (GC).

GC Analysis: Analysis was conducted on a Hewlett Packard HP5890 Series II gas chromatograph using a HP-5 column (0.32 mm x 30 m x 0.25 µm film thickness), helium as carrier gas at a flow rate of 1.75 mL/min, split ratio of 55:1, and flame ionization detection (FID). The injection volume of the essential oil sample for GC analysis was 1 µL. Two temperature gradient programs were used. Program 1: initial temperature 50°C, equilibrated for 3 min, elevated to 250°C at a rate of 5°C per min, kept for 5 min at 250°C. Program 2: initial temperature 50°C, equilibrated for 3 min, elevated to 150°C at a rate of 10°C per min, kept at 150°C for 5 min, elevated to 180°C at 5°C per min, kept for 3 min, elevated to 280°C at a rate of 7°C per min, kept for 25 min. In both programs, the inlet and detector temperatures were set at 250°C. β-Bisabolol in essential oil was positively identified by GC by analysis of pure β-bisabolol standard. Other compounds were identified by GC-MS analysis. Content of major essential oil constituents is expressed as peak area % (relative concentration).

Results: German chamomile yielded 0.193% essential oil, which consisted of 37 compounds of which 7 main ones are reported in Table 1. The GC profile of essential oil is presented in Figure 1. Main volatile that comprised 44-46% of the oil was □bisabolol (peak retention time 29.5 min), followed by chamazulene (around 15%). □Bisabolol and camazulene are the most active constituents and the most valuable constituents of essential oil. Certain chemotypes of chamomile contain up to 62% of □bisabolol and up to 21% chamazulene, but this is not commonly found on the market. Content of farnasene is very variable and depends upon a quantity of the green flower parts. Content of all volatile compounds is expressed as a relative peak area percent. Oil is of nice dark blue color due to high content of chamazulene, and had a pleasant odour typical for German chamomile. Overall, quality was good and comparable to the products on the market. Oil yield, typically in the range of 0.2 to 1.0%, is at the lower end of the scale, which may be due to following reasons: that the chamomile variety grown was low yielding, and/or not harvested at the optimal time, and/or that a plant material sample contained higher proportion of stems than commonly found in the industry. All these conditions could be

relatively easily corrected and optimized. GC data were reproducible regardless of the temperature program used.

Table 1. Content of major volatile compounds in German chamomile essential oil (Program 1)

Essential Oil	**24.2 min** β-farnasene (%)	27.2 min not conf. (%)	28.9 min bisabolol oxide b	29.5 min -bisabolol (%)	30.6 min chamazulene (%)	30.8 min not conf. (%)	33.5 min not confirmed (%)
Intact	11.72	1.84	4.25	45.72	15.36	2.32	7.72
Extracted with ether	12.21	1.85	4.18	43.86	14.97	2.23	7.52

[1]Content of volatile compounds is reported as a relative peak area %

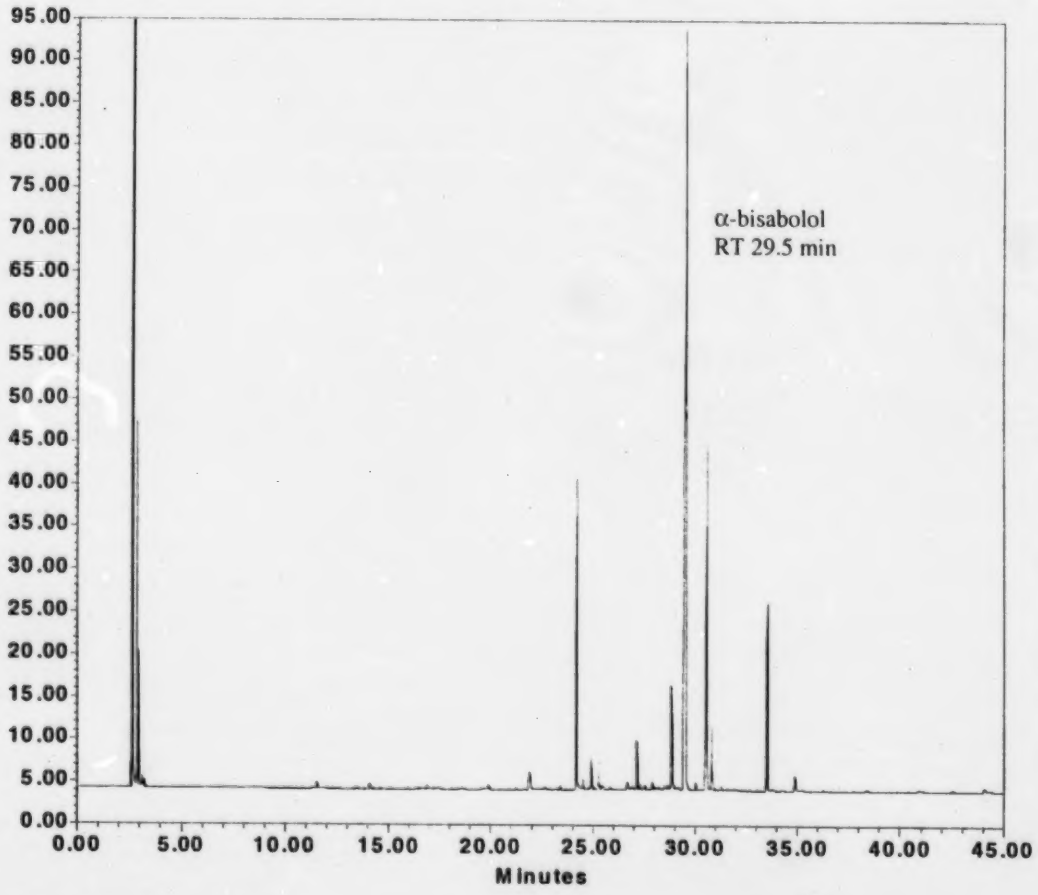

Figure 1. GC profile of German chamomile essential oil obtained by temperature Program 1.

Summary of the Phytomedicinal Quality of Herbs Grown for the Project "Medicinal Herb Production in Northeast Saskatchewan"
April 2002

Over the past three years, seven samples of medicinal herbs harvested from one of the two experimental sites, the Northeast Demonstration Farm north of Tisdale and/or the Conservation Learning Centre, south of Prince Albert, were received for analysis. Dry clean samples were stored at a dark place at 10°C and humidity below 50% prior to analysis. Samples were ground to a fine powder and analyzed by a suitable and different method for each herb using HPLC (high performance liquid chromatography). Analytical methods were either developed by the Herb Research Program (HRP) or were adopted from the scientific literature, and are recognized by the herb industry. Quality of all herbs tested ranged from good to excellent.

Narow-leaved Echinacea (*Echinacea angustifolia*)

It is unclear what compounds are responsible for the immunostimulatory activity of echinacea, but the content of phenolic compounds, specifically caffeic acid derivatives echinacoside, cynarin and chlorogenic are used to describe quality in herb trade. Most often, level of echinacoside is used as a single indicator of phytomedicinal quality of *E. angustifolia* root. Root sample received on July 14, 2000 (small sample of broken roots likely from a single plant), contained 2.00% echinacoside, 0.33% cynarin, and 0.44% chlorogenic acid. Root sample of similar size received on September 21, 2000, contained 1.36% echinacoside, 0.22% cynarin, and 0.12% chlorogenic acid. These data suggest that both echinacea root samples are of excellent quality. According to HRP experience, an average quality root grown in Saskatchewan contains 0.7-0.8% echinacoside. Considering high variability in quality between plants within a same population and in order to ensure better representation of root for a given field, it is recommended that in future entire roots of at least five randomly collected plants throughout the field be provided for quality testing. It is of interest to note that former HRP studies have suggested that drought and nutrient stressed echinacea plants growing in the wild tend to accumulate phenolic compounds at a higher rate than their cultivated counterparts.

Valerian (*Valeriana officinalis*)

Compounds associated with the quality of valerian roots are valerenic acids, essential oil and valepotriates. In herb trade valerenic acids content is most commonly used. It varies greatly from year to year and depends on the root age and time of harvest. High quality material is reported to contain 0.5% valerenic acids consisting of valerenic acid, acetoxy-valerenic acid and hydroxy-valerenic acid (minor), but no method of determination was specified. Two-year old valerian roots grown under plastic mulch (represented by 4 single roots) and with no plastic mulch (represented by one single root) grown near Tisdale were provided for analysis on January 14, 2000. First contained 0.13% valerenic acid, and the second contained 0.15% valerenic acid. Pure reference standard of acetoxy-valerenic acid was not available at the time of testing, therefore its content was not determined. However, acetoxy-valerenic was well separated from valerenic acid by the HPLC method used, and was present at a level similar to valerenic acid, as judged by the peak size. Average content of valerenic acid in valerian root

analyzed by the HRP to date is around 0.12%; the highest content detected is 0.25%. Overall, quality of valerian grown in Northeast Saskatchewan was good and marketable. It is premature to comment on the effect of plastic mulch on quality due to small sample size. In our limited experience, two-year old root contains higher amount of valerenic acid than one-year old root, but given high incidence of aster yellows disease and other factors, it appears more cost effective to harvest the roots in the fall of the first year.

Astragalus (*Astragalus membranaceus*)

The triterpene glycosides (saponins) known as astragalosides are believed to be one of active principles of astragalus root, widely used for support of immune system in Chinese herbal medicine. Astragalus on the North American market is still mainly imported from China. Information of levels of astragalosides in root are scarce. According to a resent single source, total saponin content in astragalus products on the market varied from 0.019 to 0.184% as determined by HPLC. A sample of astragalus root provided on October 30, 2001 contained higher than 0.14% of astragalosides (total saponin content), which suggests very good quality. Main compound is astragaloside I.

Feverfew (*Tanacetum parthenium*)

The phytomedicinal quality of feverfew, used for preventative treatment of migraine headache, is linked to the amount of parthenolide, the main sesquiterpene lactone in feverfew. Feverfew plants vary widely in parthenolide content due to various origin. Also, distribution of parthenolide throughout the plant changes during plant development, which suggests a great impact that harvest time and harvest practice may have on quality. Crude drug should consist of the dried aerial parts or dried leaves of feverfew and contain not less than 0.2% of parthenolide. A sample of dry feverfew leaves, stems and flowers received on January 27, 1999, was found to contain 0.41% parthenolide. According to HRP experience, this is an average or slightly below average parthenolide content, which suggests that plants could have been cut low to the ground and consequently contained more than optimal amount of stems devoid of parthenolide. The HRP has documented in earlier studies that flowers in full bloom of desirable chemotypes commonly contain 1.3-1.5%, and leaves up to 0.5% parthenolide. It should be emphasized that parthenolide content is significantly influenced by the seed source.

German Chamomile (*Matricaria recutita*):

The phytomedicinal quality of German chamomile, an anti-inflammatory herb, is associated with the essential oil content and composition, and to some extent by the flavonoid content. Sample of flower heads which contained noticeable amount of stems received on October 30, 2001, yielded 0.193% essential oil. Essential oil consisted of 44-46% of α–bisabolol and around 15% of chamazulene, which are active principles and the most valuable constituents of essential oil. Oil had nice dark blue color due to high chamazulene content and a pleasant odor typical for German chamomile. Overall, quality was good and marketable. Essential oil yield, typically in the range of 0.2 to 1.0%, is at the lower end of the scale, which may be due to one of the following: the variety was low yielding, and/or not harvested at the optimal time, and sample contained higher proportion of stems than recommended.